Multi-Metric Evaluation Tool for Restoration of NJ's Tidally Influenced Wetlands

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NJ Water Monitoring Council

Measuring What Counts for Clean & Plentiful Water

May 19, 2016

Dorina Frizzera, Environmental Scientist I
NJDEP, Division of Science, Research and Environmental Health

Outline

- Importance of Wetlands
- Status of Wetlands
- Monitoring
- Trend Towards Restoration
- Baseline Characterizations
- Interactive Tool
- Other EPA Grant Tasks

Importance of Wetlands

- Play a critical role in the provision and maintenance of clean water
- Habitat
- Flood Protection
- Storm Surge Abatement
- Carbon/Nitrogen Sequestration
- Aesthetic Value (translates to economic value through tourism, recreation and commercial interests)

Condition of Wetlands

- Condition is the cumulative effect of multiple impacts or disturbances on the health of a coastal marsh.
- The evaluation of marsh condition requires the assessment of physical and/or biological parameters to describe the level of impairment or to gauge the performance of key ecosystem services or functions.
- The interaction of physical, chemical and biological factors affect wetland condition.
- Additionally, anthropogenic activities and management practices may also affect wetland condition.

Reference Sites

- Use of Reference Sites more common as resource managers search for “reasonable and scientifically based methods to measure and describe the inherent variability in natural aquatic systems”.
  - Reference wetlands are naturally occurring sites composed of wetland, stream and riparian components that represent areas of minimal human disturbance.
- Primary reasons to include reference sites in restoration efforts is the need to compare impacted or degraded sites to a least – impaired set of attributes or benchmarks.
  - To provide appropriate design and performance criteria
  - To serve as a benchmark or starting point for trend analysis (long-term successional studies, impact analysis and or restoration target)

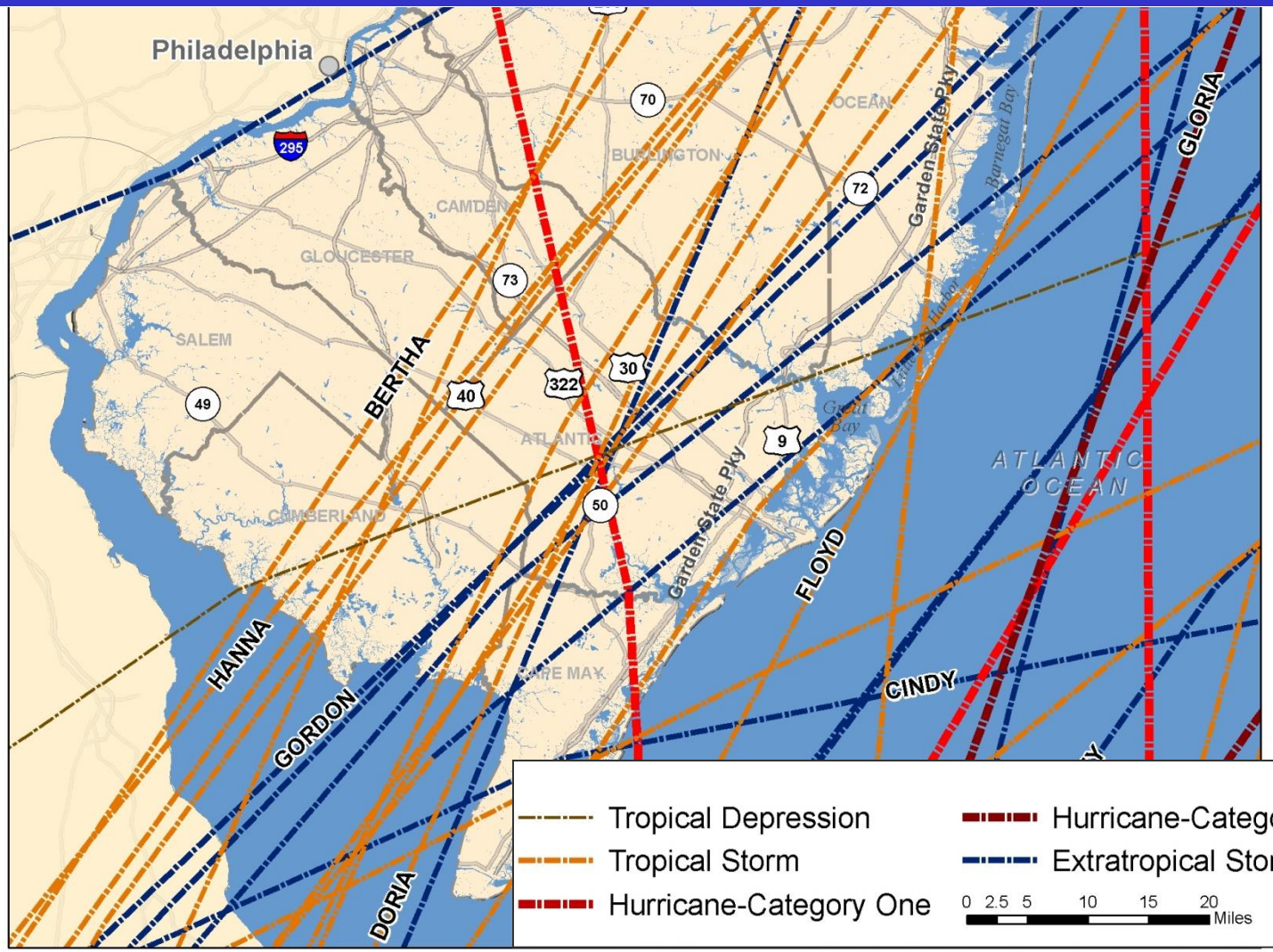
Challenges Facing the NJ Coastline and its Wetlands

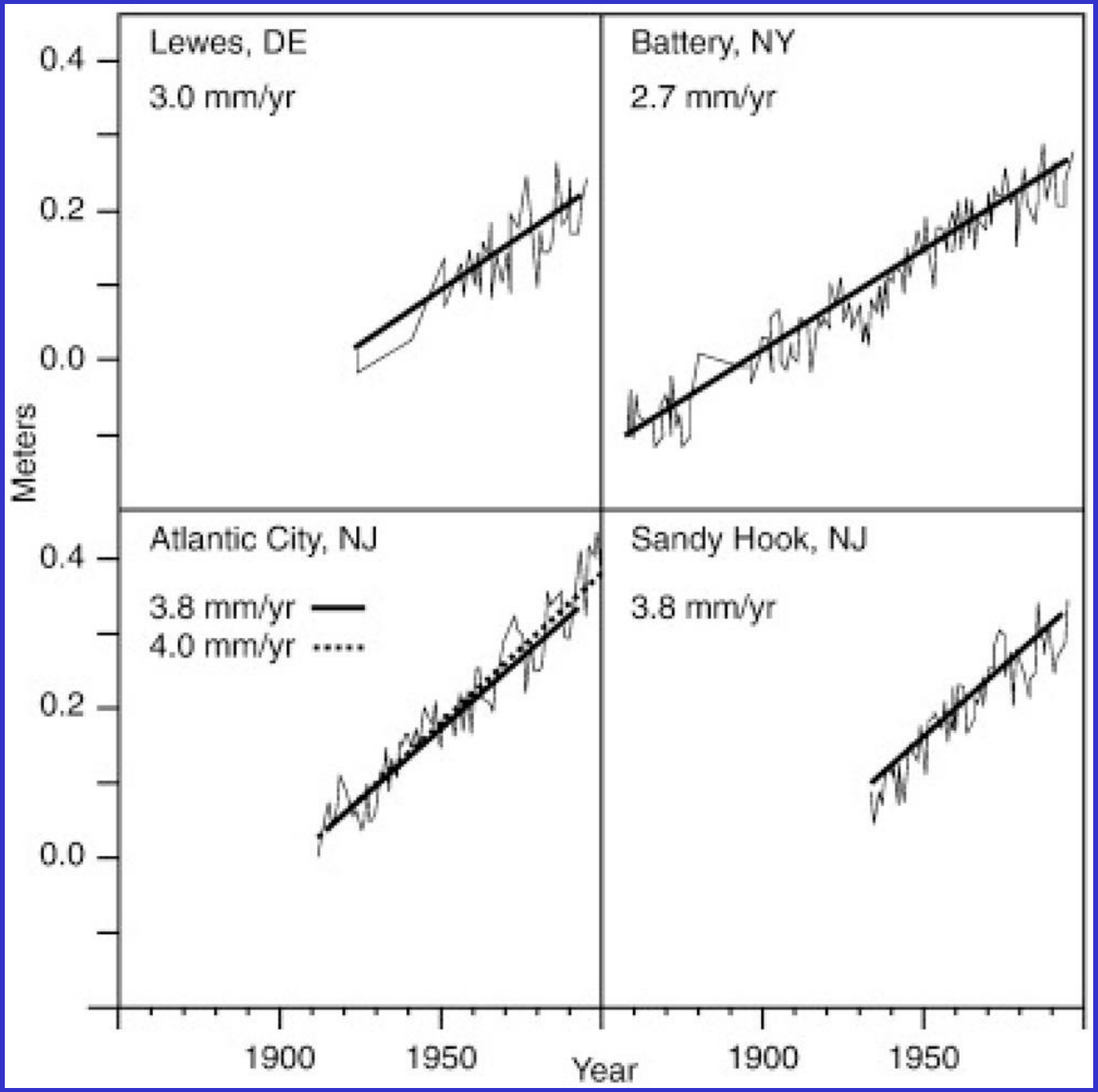
- Shallow Coastal Flooding
- Nor'easters
- Tropical Storms
- Hurricanes
- Storm Surge
- Sea Level Rise
- Erosion
- Wind
- Subsidence (compaction)

October 1991 Nor'easter

Historic Storm Tracks 1850-2008

GIS Source: NOAA Coastal Services Center




Lewes, DE
3.0 mm/yr
Battery, NY
2.7 mm/yr
Atlantic City, NJ
3.8 mm/yr
4.0 mm/yr
Sandy Hook, NJ
3.8 mm/yr
Meters
0.4
0.2
0.0
1900
1950
Year

Past 80 years = 1 ft. rise.

2050 =

1.3 additional feet

2100 =

3.1 additional feet

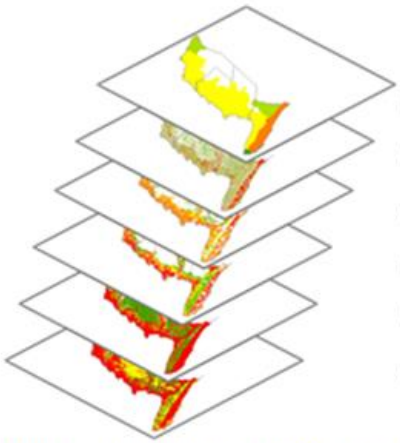
K. Miller and R. Kopp – Rutgers University


10/02/2015


10/08/2015

STRESSORS + VULNERABILTY = DYNAMIC IMPACT

Coastal Vulnerability Index
Identifying Susceptible Land Areas



Where CVI =

(a) Geomorphology

(b) Slope (% Rise)

(c) Flood Prone Areas

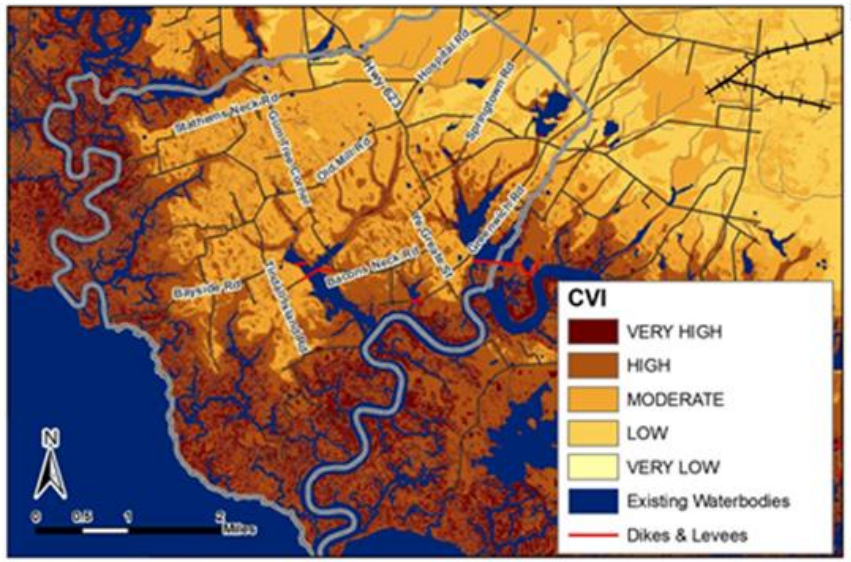
(d) Storm Surge (SLOSH)

(e) Drainage

(f) Erosion

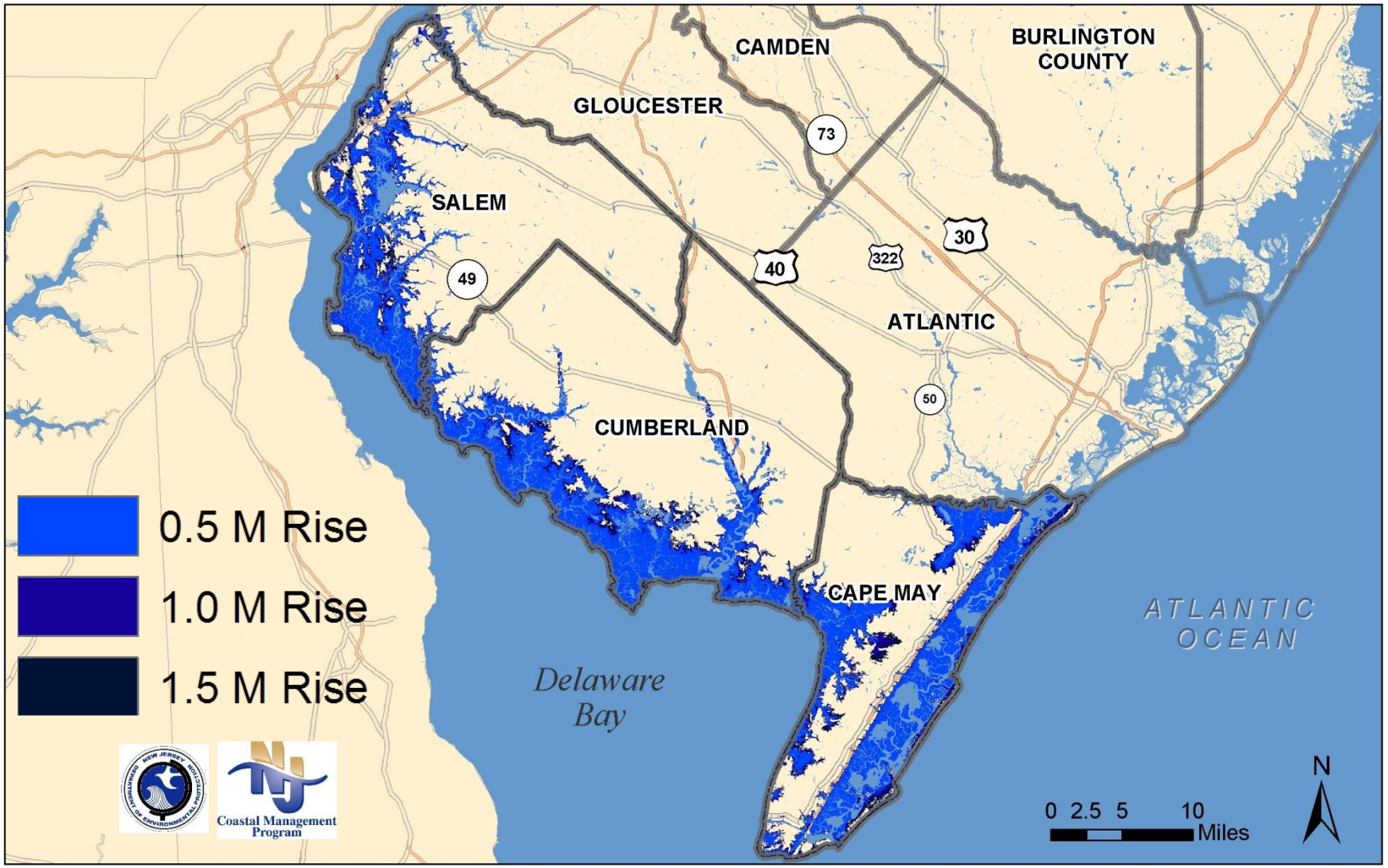
Methods Adapted from: NOAA CSC; Hazard & Vulnerability Institute;

Coastal Vulnerability Index

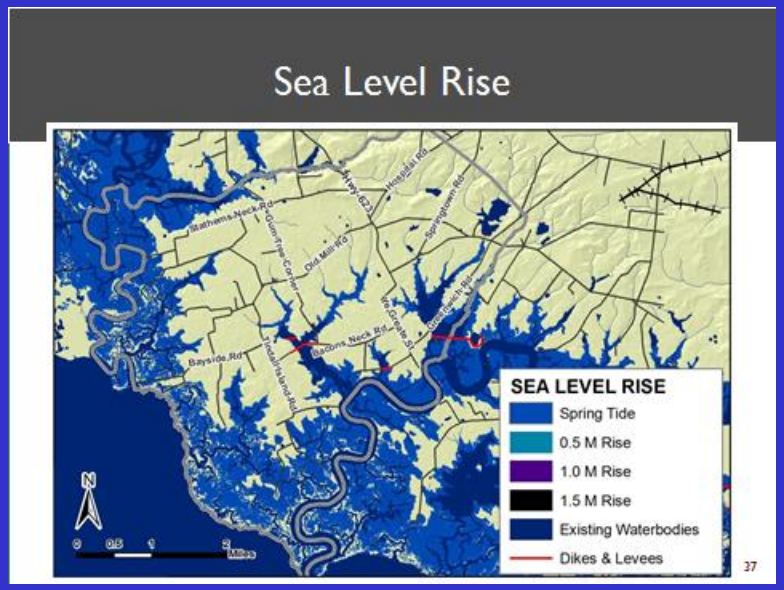


Sea Level Rise Along the Delaware Bay

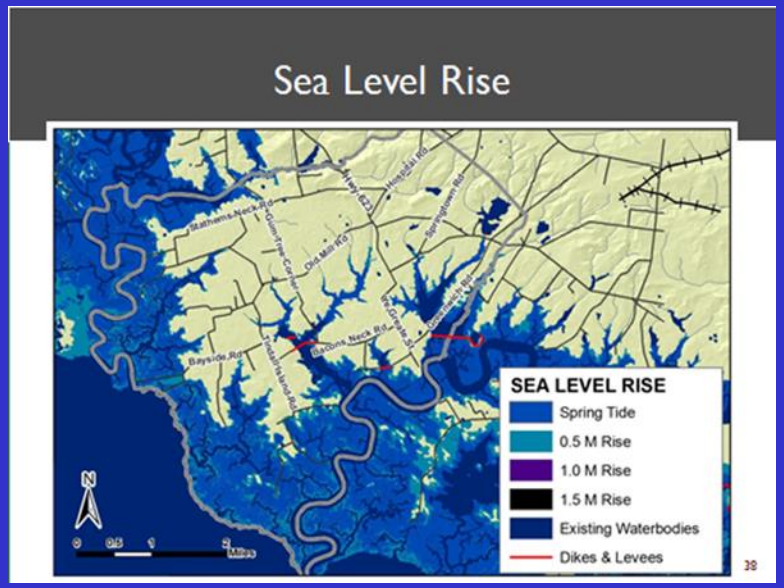
Inundation at Mean High Higher Water



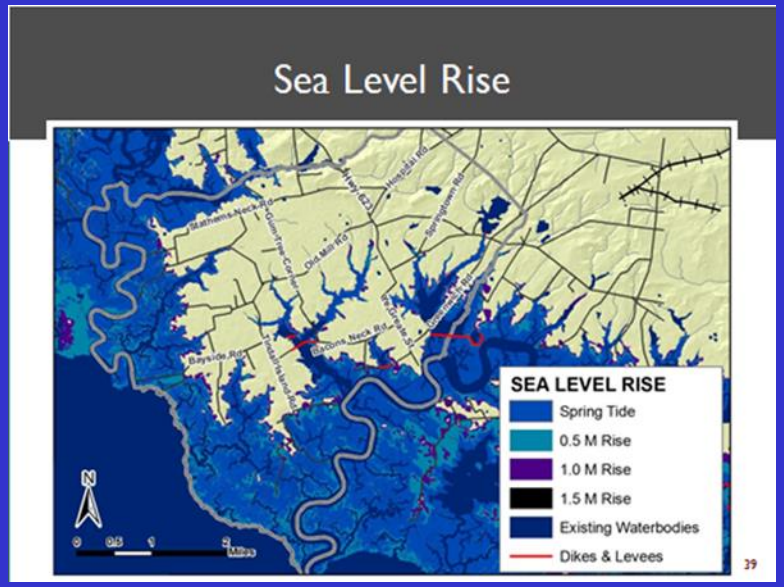
Spring Tide



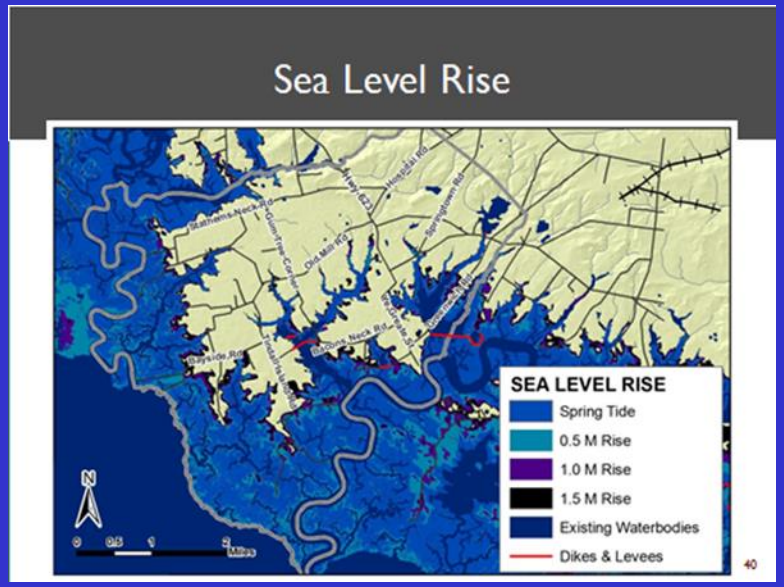
.5 meter Sea Level Rise



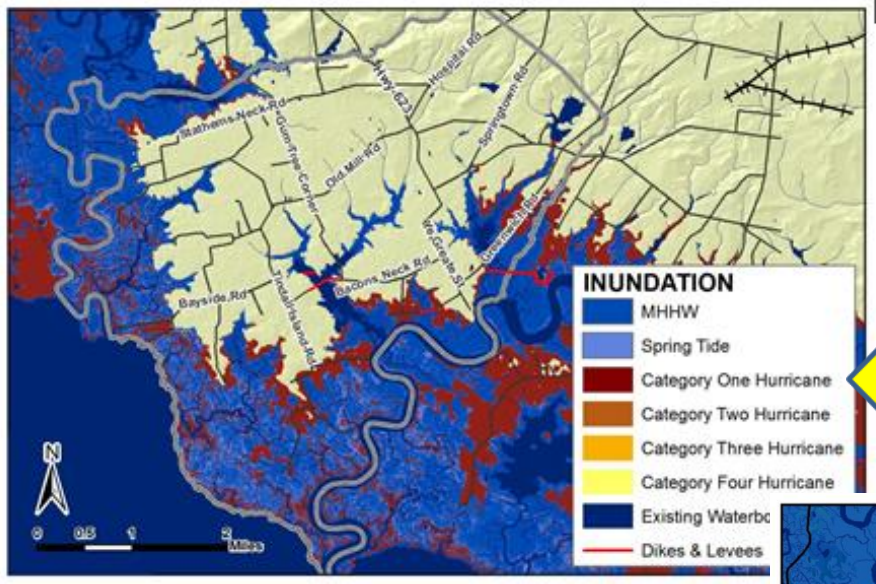
1.0 Meter Sea Level Rise



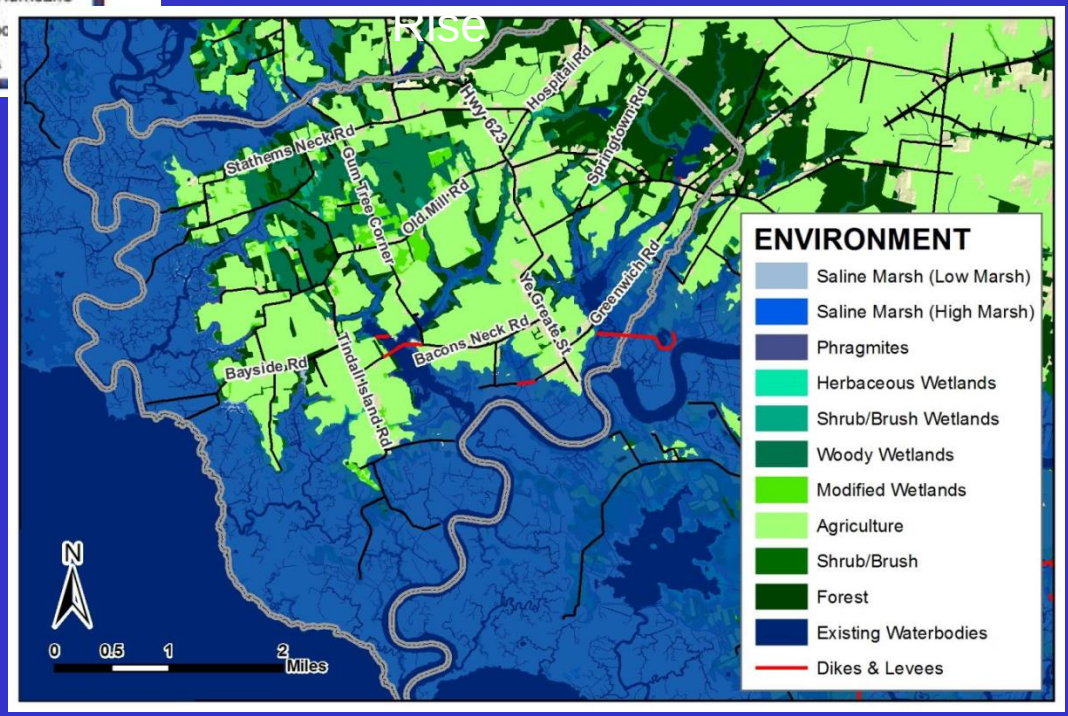
1.5 Meter Sea Level Rise



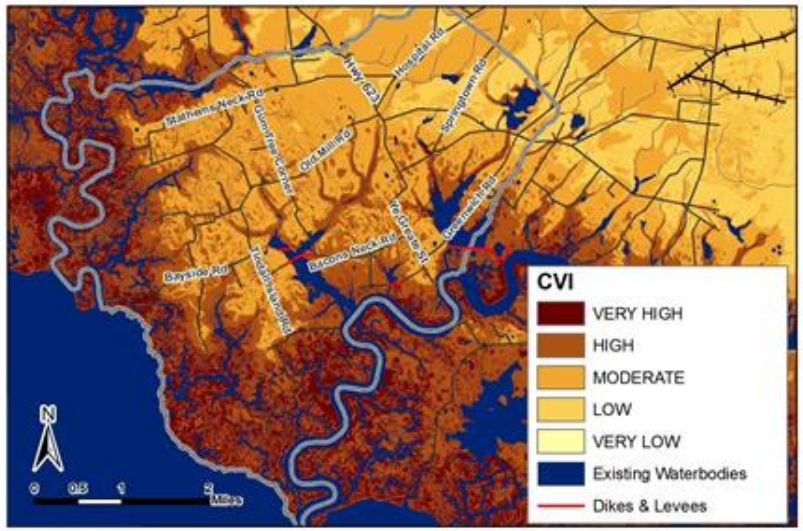
Storm Surge



1.0 meter Sea Level Rise

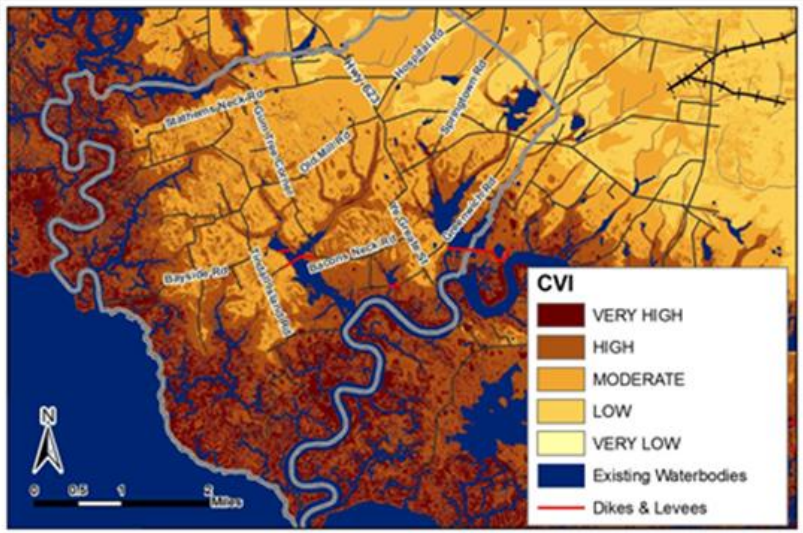


Coastal Vulnerability Index
0.5 Meters of Sea Level Rise



45

Coastal Vulnerability Index
1.0 Meters of Sea Level Rise



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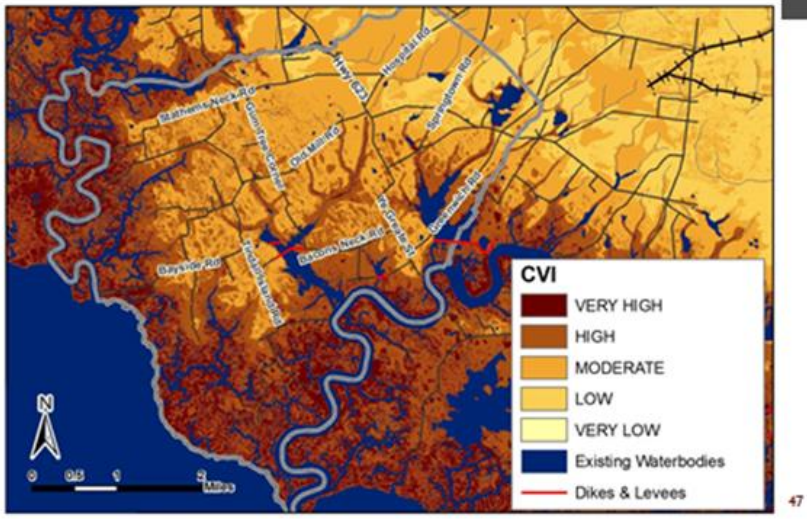
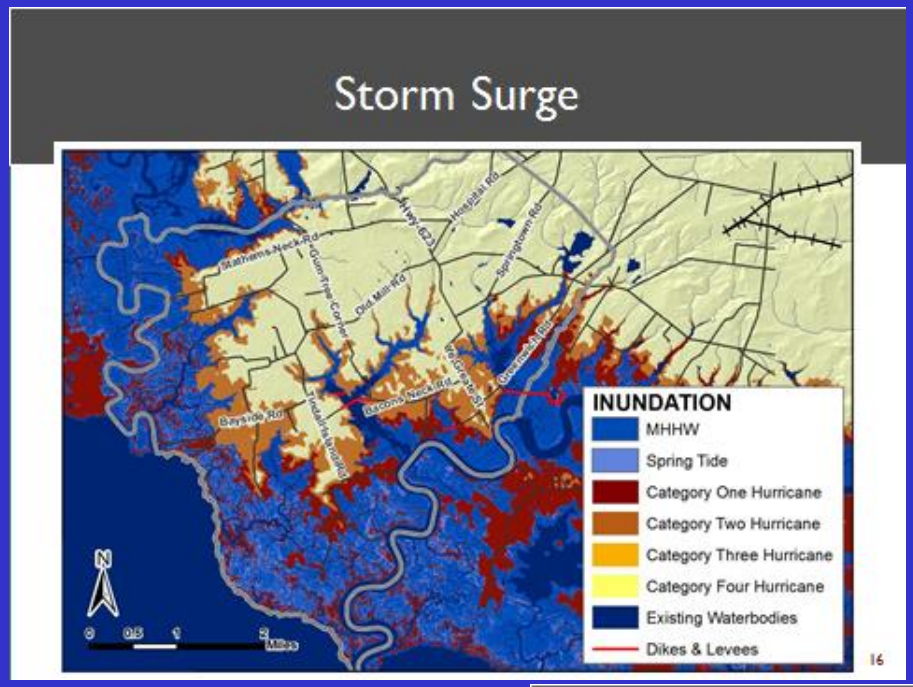
Coastal Vulnerability Index
1.5 Meters of Sea Level Rise

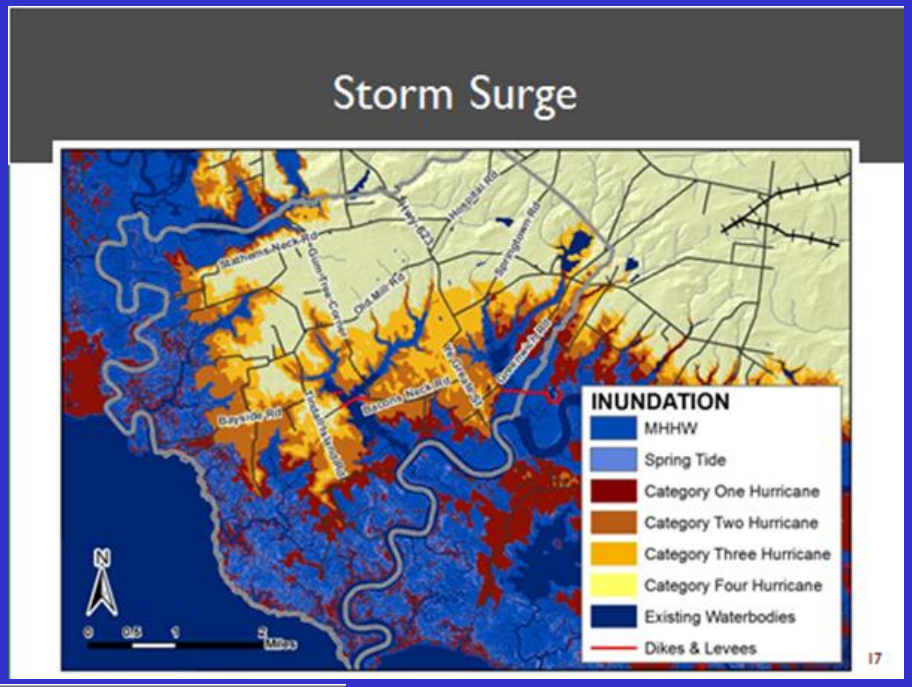


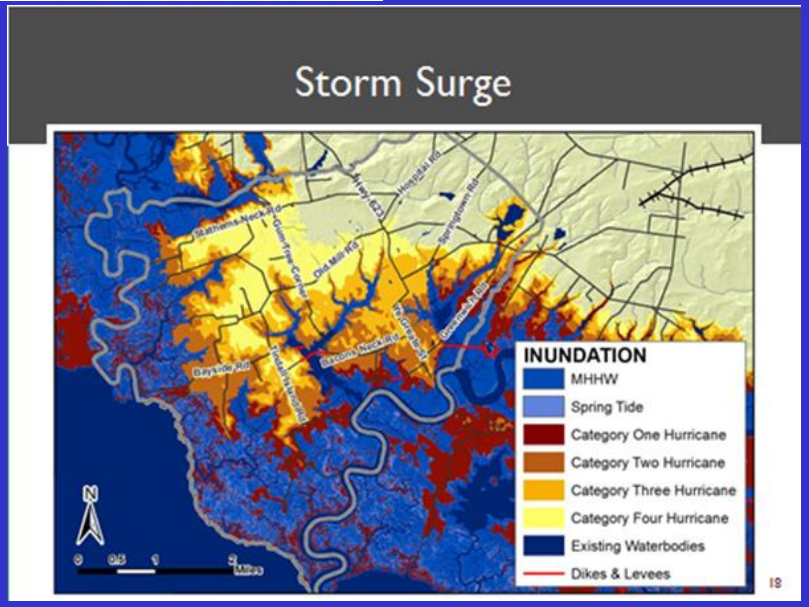
47

Category 2



Category 3



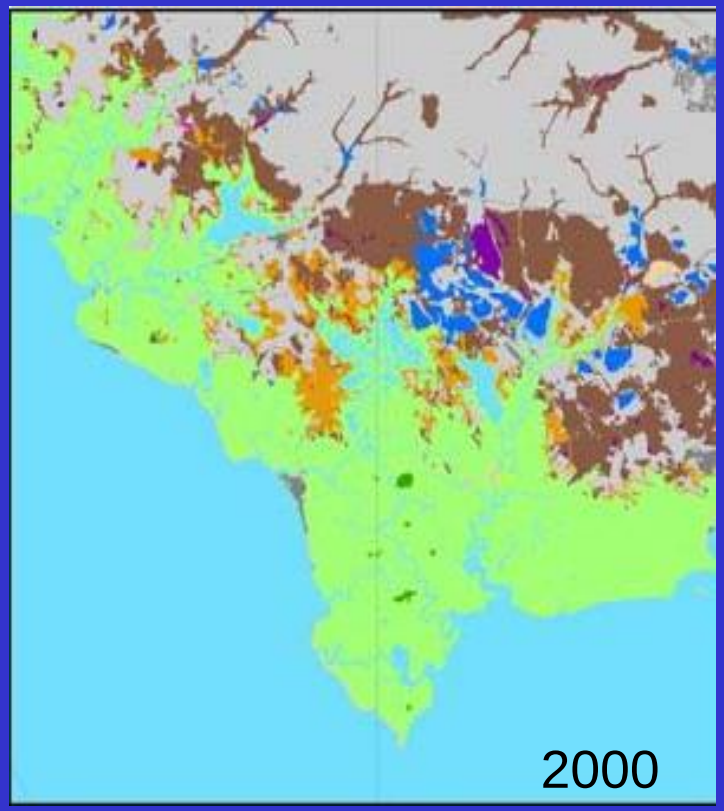


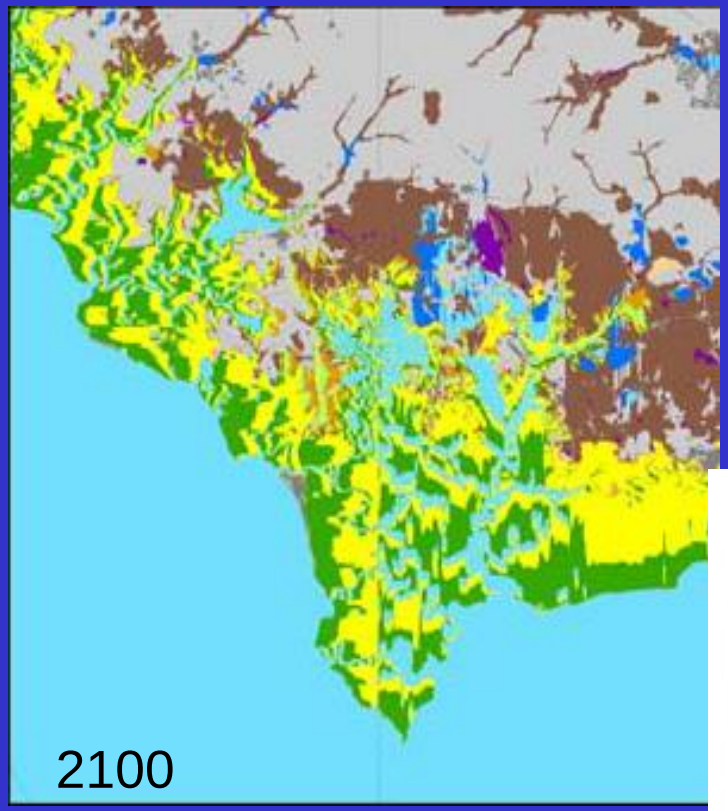
Category 4

What If We Don't Take Action?

>25% Loss of tidal wetlands!

- Conversion of >40,000 ha Uplands to Wetlands
- Conversion of >100,000 ha Wetlands to Water
- Loss of Services >> Acreage Losses





Wetlands Protection in New Jersey

- Acquisition
- Mapping
  - Tidelands Claim
  - Upper Wetlands Boundary
  - Wetlands Vegetation Delineation
- Geography of Wetlands – to vast to cross to shoreline
- Regulation
  - Public Trust Doctrine (protecting public use of tidally flowed lands and adjacent trust lands)
  - Prohibiting Development
  - Controlling Stormwater and Riparian Crossings
  - Mapping and Claim of Tidelands

Wetlands Protection - Continued

- Regulation
  - Federal and State Regulations
    - Administrative (Guiding Uses)
      - Extraction
      - Fill and or Deposition
    - Resource Specific
      - Fish, Flora, Fauna
    - General Permit (GP 29)*
  - Public Trust Doctrine (protecting public use of tidally flowed lands and adjacent trust lands)
  - Prohibiting Development (State and Local)
  - Controlling Stormwater and Riparian Crossings
  - Mapping and Claim of Tidelands

Trend Towards Wetland Restoration

- In large part Hurricane Sandy was a ‘game changer’
  - Recognition of the value of ecosystem services provided by wetlands to the built environment
  - While wetlands performed well (did what they were supposed to)
    - The areal extent of wetlands was diminishing
    - Ability of wetlands to sustain future assaults (storms)
    - Recovery
  - Federal funding to restore wetlands
    - Programs that focused on acquisition opened opportunities to restoration
    - Grants specifically for restoration
    - Tying restoration of wetlands to resiliency of the built environment

GENERAL CONSIDERATIONS for RESTORATION

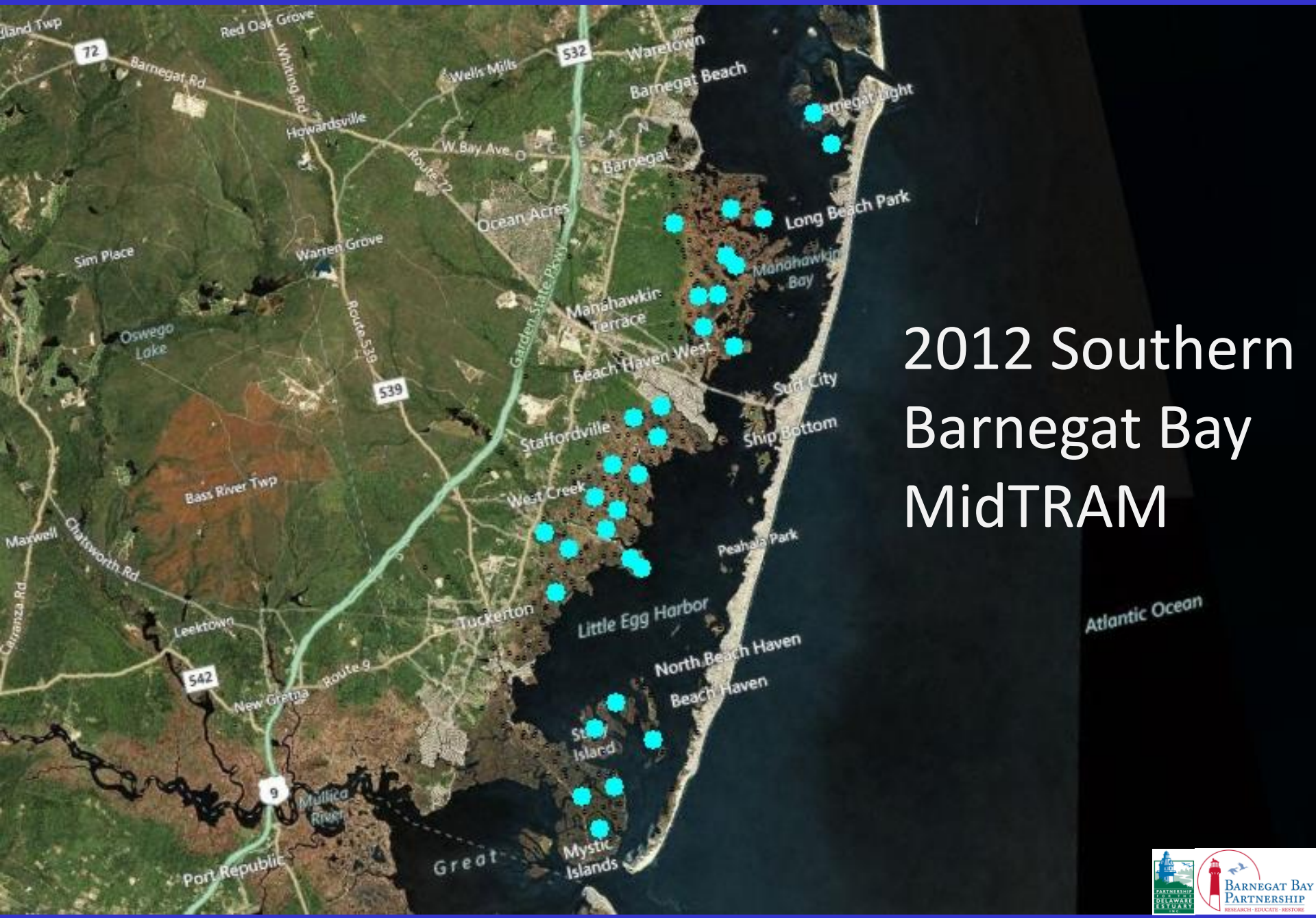
- Adaptation is local – actions and strategies must be responsive to local conditions.
  - Use monitoring data to inform reference conditions; in baseline characterizations and to set recovery trajectories
- Multi-metric approach must be considered
  - Use multiple criteria to evaluate the net benefit of the design being considered.
  - One parameter will not lead to success
- Past conditions or approaches cannot be used because the conditions are changing.
- Consider a benefit/cost analysis for each of the strategies being considered.
- Trade-offs; Loss of ecosystem services during restoration
- Natural and human systems respond differently – adjust your strategy appropriately and be aware of unintended consequences.


10/07/2015

Monitoring of New Jersey's Wetlands

- National Wetland Condition Assessment
- Mid-Atlantic Coastal Wetland Assessment
  - Mid-Tram
    - Rapid Assessment Method
  - Site Specific Intensive Monitoring Network (SSIM)

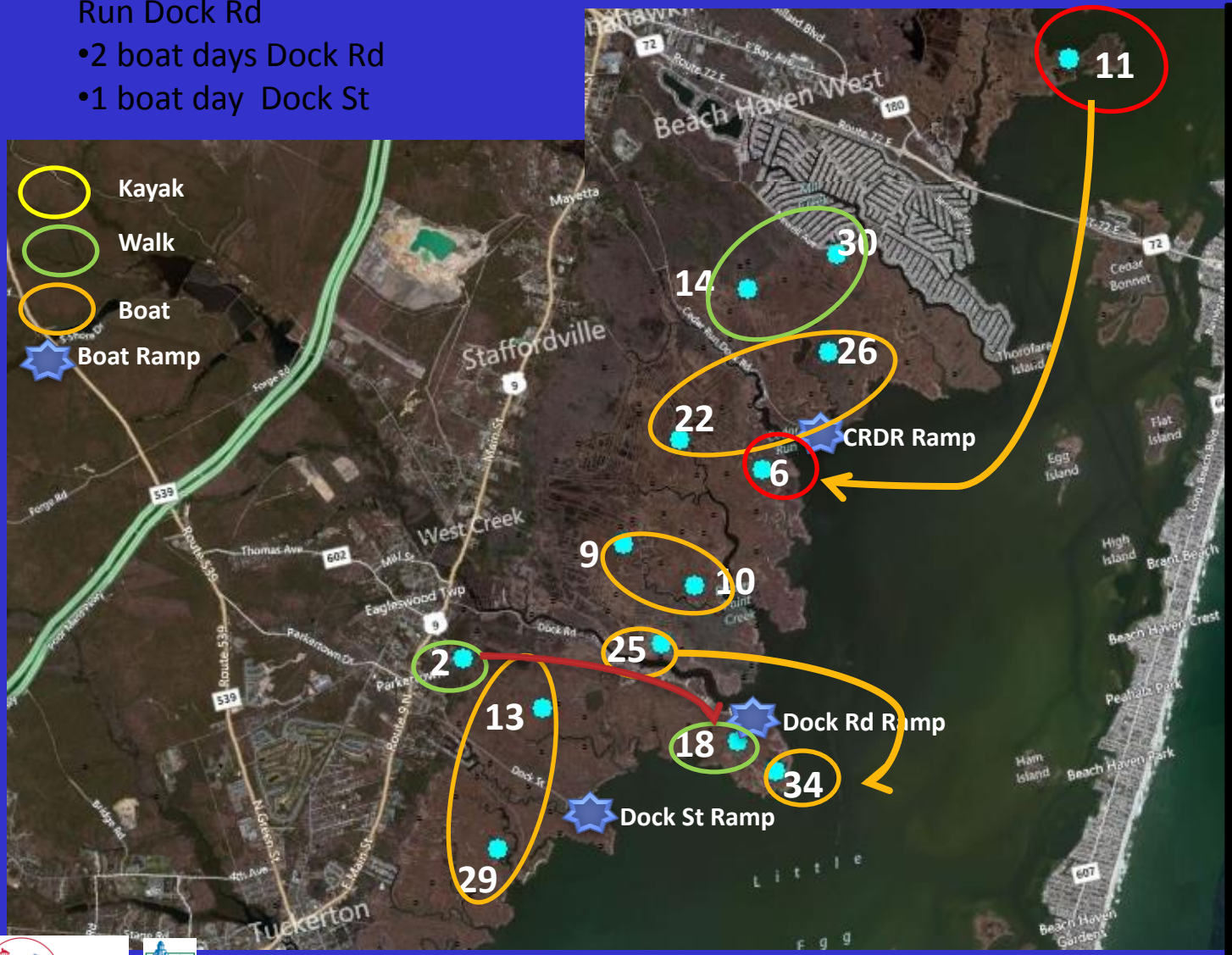
29



2012 Southern Barnegat Bay MidTRAM

Barnegat Bay Partnership
Research · Educate · Restore

- 2 boat days Cedar Run Dock Rd
- 2 boat days Dock Rd
- 1 boat day Dock St



Boat ramp name and "plan B" are in parentheses

August 20th-11 &6- Boat (CRDR)

August 21th- 26&22 – Boat (CRDR)

August 22th- 9 &10- Boat (DR)

August 23th- 25 &34- Boat (DR)

August 27th- 13 &29- Boat (DS)

August 28th- 28 &12- Boat (MI)

August 29th- 16&32 – Boat (MI)

August 30- 24 &8- Boat (MI)

September 4- 2 &18 (18)- walk (or a Friday in august)

September 5, 6- Back up days

Inter-active Tool

- From 1993 to 2003 the Penn State Cooperative Wetlands Center (now Riparia) established a set of 222 reference wetlands for Pennsylvania.
- In 2008 with funding from EPA Region 3, Riparia began to process and compile the reference wetlands data into an interactive, web-based database – Riparia Reference Wetlands Database.
- This web based approach provides for wide range of environmental and agricultural decision support tools that combines inter-active, data rich interface with geospatial capability.
- This tool is live and available to the public

- However, until this project 'coastal, tidally influenced' wetlands were not included in the database.

Inter-active Tool

- This interactive tool allows for a three level/step approach to assessment
  - One data base of wetland assessment locations
  - Level 1 – Landscape Assessment
    - Reference standard vs Disturbed (stressed) site
  - Level 2 - Identification of Stressors
    - Hydrologic Modification
    - Sedimentation
    - Dissolved Oxygen
    - Contaminant Toxicity
    - Vegetation Alteration
    - Turbidity
    - Thermal Alteration
    - Salinity
    - Acidification
    - Eutrophication
  - Level 3 - Intensive Assessment
    - Floristic Quality Index (FQAI)
    - Plant Index of Biological Integrity

How Does it Work

- For each wetland design:
  - Review information about site location and characteristics for selected site. Decide what type (HGM and vegetation profile) of wetland to target.
  - Log in to Riparia Database Explorer: www.riparia.psu.edu
    - Click on Products
    - Click on 3rd item in Digital Products list (or copy into browser: http://wa.cei.psu.edu/wetlands/)
  - Menu at the top, SELECT:
    - State = Pennsylvania, Delaware, West Virginia*
    - Ecoregion = Ridge and Valley, Piedmont …(appropriate for site)
    - Wetland Type (appropriate wetland type – all types for the region are included, but choose only from list of types included on list.
    - Site Type (3 choices):
      - All – is the number of available sites used to summarize the data displays
      - Reference Standard – sites are a subset of wetlands least disturbed
      - Reference Standards vs. all others – provides two bars of comparative data

How Does it Work - 2

- Click on BINOCULARS ICON (do this each time to change the field – anytime you request something different click the BINOCs to activate)

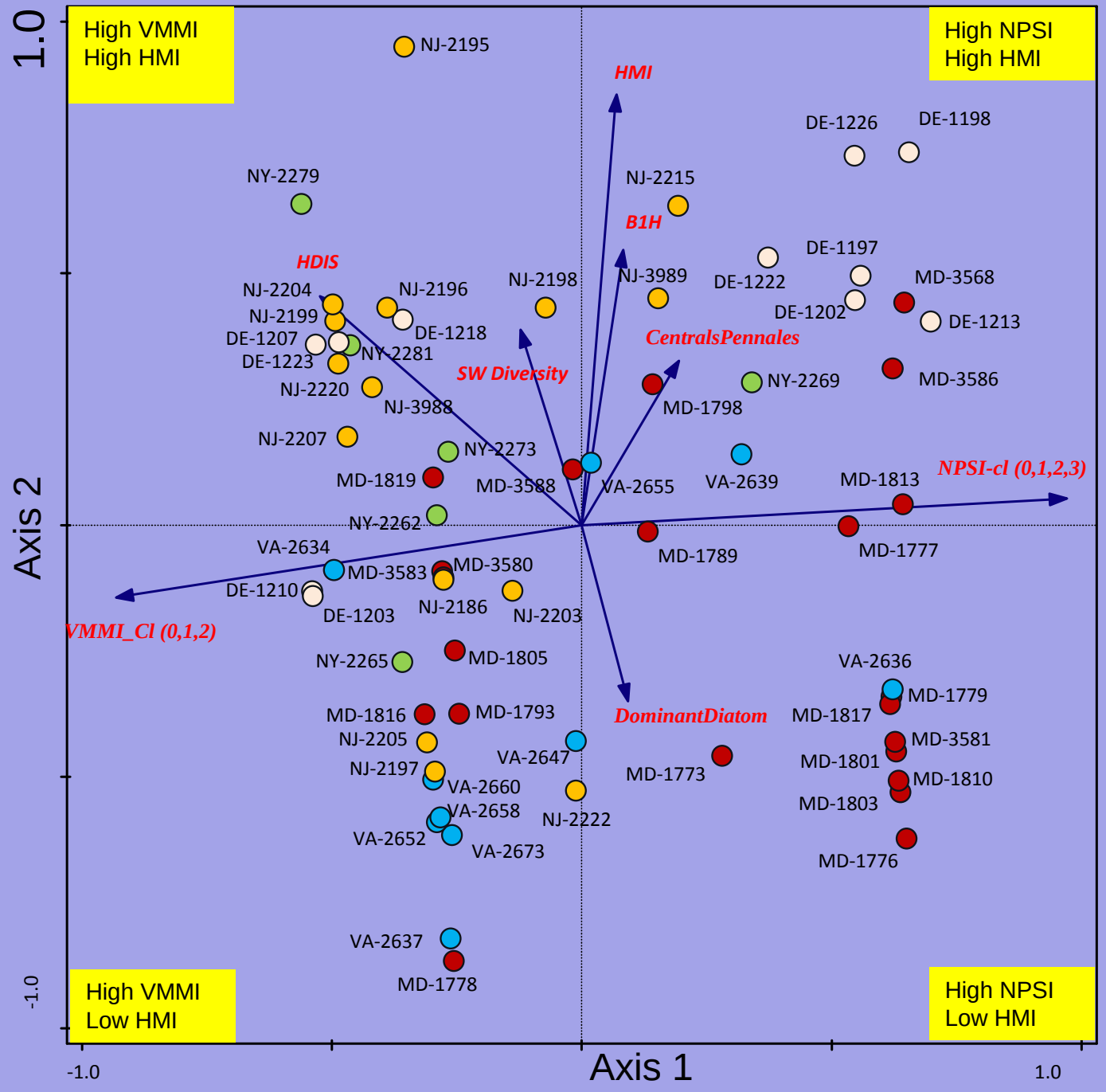
- There are other icons at the top: grids and table data; horizontal plots, HELP, Save …
- Groups of Variables include: Landscape, Hydrology, Soils and Topography, Stressors [for NJ – OMWM, Sea Level Rise, Subsidence (*using elevation from LiDAR, RTK – Real Time Kinetic Resonance where available)], Soils and Topography, Vegetation, Wildlife.

- NJ will be providing the collected monitoring and other data bases to PSU
- We'll be working closely with PSU throughout the development process
- Testing application of the tool to ongoing restoration projects to inform (if appropriate) adaptive management
- Host workshops on application and use of the Tool and data
- Continue to add reference wetlands data as they become available

Other EPA Grant Tasks

- Statistical Analysis
  - Ordination analysis of the various parameters being monitored
    - What is the relationship (if any) between the parameters and metrics being used to measure them;
    - What is the correlation between parameters within a watershed or wetland type?
    - Can this analysis of parameters be used to identify specific parameters needed to be captured during baseline characterization; setting reference conditions and restoration trajectory; monitored during restoration; and measuring success.
- Installation of two SSIMs (3 SETs each) in the Raritan watershed to enhance the MACWA Network and link to MERI.

Mid-Atlantic Coastal Wetlands sites from National Coastal Assessment (2011)



64% Variance explained on axes 1 and 2

Contact Information

- NJ DEP – Division of Science Research and Environmental Health
  - Dorina Frizzera, Environmental Scientist I
    Dorina.Frizzera@dep.nj.gov
  - 609-984-7739

Questions ?

Thank You

- EPA Region 2 – Wetlands Conservation Planning Grant
- Robert P. Brooks, Director
  - Riparia at Penn State
- Mid-Atlantic Coastal Wetlands Assessment
  - Partnership for the Delaware Estuary – Dr. Danielle Kreeger
  - Barnegat Bay Partnership – Martha Maxwell Doyle
- NJ DEP
  - Division of Parks & Forestry, Natural Heritage Program – Kathleen Walz